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PRICE BOOSTERS HELP PROFITEERS.

"Look at these shoes," said a well-dressed youth the other day. "Six weeks ago I paid $15 for them, and they have lost their shape already. Now I am having a pair made that will set me back twenty-five bucks."

He—and many more like him of both sexes—are as responsible for price boosting as the profiteers.

Extravagant buying and industrial slacking make the profiteer's paradise. Do an honest day's work and cut out needless expenditures. An encyclopedia on the H. C. of L., if it has anything worth while in it, will boil down to this.

MONTHLY REVIEW

Published by the

American Electro-Platers' Society

Editors' Office, 4156 Botanical Ave., St. Louis, Mo.

Vol. 7 JUNE No. 6

EDITORIAL.

This number of the "Monthly Review" brings to an end our year's attempt to be an "editor." It has been our purpose to do the best we could, considering the best interest of our Society as we saw it. It has been a source of gratification to feel how well we have been supported by so many of our branches and members.

With all the duties that become our lot as an "editor," as a foreman plater, and as a married man with an unfair majority of the gentler (?) sex in the family, it has been impossible at all times to write our personal appreciation to many of our members who have contributed to the "Monthly Review," and we now thank you, one and all. We believe that if others of our branches would contribute as a special, the same as Detroit, Chicago and New York branches have done, and as Pittsburgh Branch has offered to do, it would keep our publication in plenty of good material; in fact, since this was started, there has always been material held over, and we ask these contributors to be patient. Owing to H. C. L., we have kept within limits on our costs, which are continually on the increase.

Our Supreme President and Secretary and our associate editors have assisted at all times.

Every branch should contribute to "What the Branches Are Doing." A good report of a poor meeting is better than no report of a good one. It is not necessary to go into details or formal business transactions, but let your members not attending meetings know that you're still on the job. While this work is assigned to the Secretary, if for any reason he can not make regular reports, he might appoint some one to do this.

It is with pleasure that we welcome the news in this issue of the organization of a branch in Boston. Pittsburgh can now move up a notch, as it is no longer the baby branch.

Now for Rochester convention. We hope to see some there who were missed at Philadelphia last year, and, of course, many who will attend for first time. See trade papers for description of Rochester's industries and the program, and then come.

PRINCIPLES OF ELECTRO-PLATING. III.*

(By Dr. O. P. Watts.)

Continued from May "Monthly Review."

Effect of High Current Density.

If a single object be hung in any plating solution and the current be increased in successive steps, some parts will presently receive a rough and dark-colored deposit, known as a "burnt deposit." Points nearest the anodes will first show this effect, i. e., places where the current density is highest. If after noting the current at which "burning" occurs, the solution be diluted and the current be again raised until burning again occurs, it will be found to happen at a smaller current than before. Increasing the amount of metal in the solution will raise the CRITICAL CURRENT DENSITY, i. e., the current density at which burning takes place.

A common error is to ascribe burning to the liberation of hydrogen on the work: its cause is the use of a current density too great for the amount of metal in the fill of solution in contact with the cathode, from which all metal that plates out must be drawn. Deposition of hydrogen from most plating solutions requires a very high current density, and hence it often accompanies burning, although not the cause of it.

If we try to picture the process of plating we think of the thin film of solution which is in contact with the cathode as having its metal removed by the current, and becoming weaker than the main body of the solution, while the film at the anode is receiving metal from the anode and so becoming richer in metal than the rest of the electrolyte. The result of taking metal out at one electrode and supplying it at the other is to make the film of solution at the anode more dense and that at the cathode less dense than the main body of the solution; this results in a downward flow of liquid at the anode and an upward flow at the cathode. This circulation replenishes to a slight degree the metal lost at the cathode (where metal is needed), but the important factor in supplying more metal is diffusion from the main body of solution into the film of liquid in contact with the cathode. The rate of this diffusion depends on the concentration of the solution in metal, hence the need for a concentrated solution when a high current density is to be used in plating from a still solution.

Increase of temperature hastens the rate of diffusion, and hence a higher current density can be used in a hot than in a cold solution of the same metal content.

Effect of Stirring.

The most effective method of supplying the necessary metal to the film of solution in contact with the cathode is to stir the electrolyte vigorously. By the use of a strong and hot

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nickel solution, with vigorous stirring caused by rotating the cathode, the author has succeeded in obtaining a good nickel deposit at a current density of about 1900 amperes per square foot, and by the same means a student has recently deposited copper plate at 4,000 amperes per square foot with a current efficiency of 95%. It is for the purpose of breaking up the film of dilute solution at the cathode that motion plating is almost universally used in depositing silver.

It is apparent that current density, not E. M. F., determines the quality of the deposit. The voltage may be anything that is necessary to send the proper current through the electrolyte, and may be made large or small by varying the distance between electrodes without the slightest effect on the deposit, so long as the current density is kept constant.

The very general use of the voltmeter alone as a means of regulating the current density is unfortunate. Although the plater cannot know exactly how many square feet of metal he is plating, and so cannot know what current density he is using, by means of the ammeter he can learn what current gives best results with the tank fully loaded, half loaded, etc., and is far more certain to keep within the proper current density than if he has to depend on the indications of the voltmeter alone. In a properly equipped plating room it should be possible to read the current in every tank in the shop by means of an ammeter. It is not necessary to have an ammeter for each tank; by a suitable arrangement of cables and switches, or by the use of several shunts for a single ammeter dial, it is possible to make one ammeter serve for a number of tanks, just as the voltmeter usually does. In justice to himself every plater should insist on having an equipment of ammeters.

Table No. 4.

Current densities to be used for the plating solutions which follow:

No.	Metal Deposited	Salt in Bath	Metal per Liter Grams	G. Equiv	Eff. %	E. M. F.	Cur Den. Sq. Dm.	Per Sq. Ft.
1	Brass	Cyanide	12.8	0.16	65-70	2.7	0.3	2.8
2	Copper	Sulphate	48.4	1.58	98	...	3.2	30.
3	Copper	Cyanide	6.3	0.10	81	2.9	0.3	2.8
4	Gold	Cyanide	2.0	0.03	95	2.9	0.1	0.9
8	Nickel	D. Sulphate	11.2	0.38	92	3.5	0.3	2.8
15	Silver	Cyanide	25.	0.23	99	1.3	0.3	2.8
24	Zinc	Sulphate	22.7	0.69	100	2.2	1.0	9.3
26	Zinc	Sulphate	34.1	1.04	100	...	1.6	15.

Table No. 4 is abridged from the writer's Laboratory Manual of Electro-Chemistry; the numbering of the baths is the same as in that book, and as that of the baths which are given below.

This table not only gives at a glance the current density usually used for these solutions, but from it the proper current density for other solutions can be estimated. In estimating the

proper current density for a new bath of known composition, it is not the weight of metal which should be considered, but the gram equivalents of metal, for the same current may deposit one metal twice as fast as the other, and to stand the same current density one solution should contain twice the weight of metal that is in the other. The gram equivalents per liter are obtained by dividing the grams per liter by the chemical equivalent of the metal. Suppose a sulphate and a cyanide solution to contain the same amount of copper per liter. It might seem that they should stand the same current density without burning; but when it is considered that the chemical equivalent (atomic weight divided by the valence) of copper is 31.5 for the sulphate and 63 for the cyanide solution, it appears that, if the current efficiency is the same, equal currents will deposit copper twice as fast from the cyanide as from the sulphate solution, and it cannot be expected that the former will stand so high a current density as the latter. It is only by taking account of the rate at which metal is deposited from the two solutions as well as the amount of metal contained in them, that a correct idea is obtained of their relative strength for plating.

Gold solutions are usually used hot; a reason for this can be seen in table No. 1. The column of gram equivalents per liter shows that the gold solution is far more dilute than any other plating bath in the table; hence the effect of heat in preventing burning of the deposit is important.

Some Plating Solutions.

The solutions which follow have been taken from books on plating. Quantities are in most cases given both in grams per liter of water, and in ounces per gallon. Current densities are in amperes per square decimeter, and resistivities are in ohms per centimeter cube. It will be good practice to find the equivalents of a few of these in English units.

1. BRASS BATH—Roseleur's, from Pfanhauser's Elektroplatirung.

	G. per Liter	Ozs. per Gal.
Sodium Carbonate, dry, Na_2CO_3.....	10	1¼
Copper Acetate, $Cu(C_2H_3O_2)_2\ H_2O$....	14	2
Sodium Bisulphite, $Na\ HSO_3$.....	14	2
Zinc Chloride, fused, $Zn\ Cl_2$.....	14	2
Potassium Cyanide, 100%, KCN.....	40	5¼
Ammonium Chloride, NH_4Cl.....	2	¼

Cur. den. 0.3; EMF 2.7; Sp. R. 13.6: Sp. G. 1.0545 (7½°Be.); cur. eff. 65%; deposit in one hour 0.0041 mm.

Prepare the solution by dissolving the sodium salts in 400 c.c. of warm water, stir the copper and zinc salts with 200 c.c. of water and slowly stir this into the first solution. Dissolve the cyanide in the remainder of the water, and stir into the other portion of the bath, when the precipitate should dissolve.

Add the ammonium chloride and boil for an hour, replacing the water evaporated.

2. COPPER BATH. ACID.

	G. per Liter	Ozs. per Gal.
Copper sulphate, $Cu\ SO_4, 5H_2O$.....	200	26⅔
Sulphuric Acid, H_2SO_4.....	30	4

Cur. den. 1 to 3 amp.; Sp. R. 9.3; Sp. G. 1.1417 (18°Be); cur. eff. 100%.

3. COPPER BATH, ALKALINE—Pfanhauser.

	G. per Liter	Ozs. per Gal.
Sodium Sulphite, Na_2SO_3.....	20	2⅔
Sodium Carbonate, Cryst. $Na_2CO_3.IOH_2O$	20	2⅔
Sodium Bisulphite, $NaHSO_3$.....	20	2⅔
Cupric Acetate, $Cu(C_2H_3O_2)_2.H_2O$.....	20	2⅔
Potassium Cyanide, 100%, KCN.....	20	2⅔

Cur. den. 0.1; EMF 2.8; Sp. R. 14.3; Sp. G. 1.0507; cur. eff. 71%; deposit per hour 0.0056 mm. Temp. 20°C.

4. GOLD BATH. For regular gilding on all metals—Pfanhauser.

	G. per Liter	Ozs. per Gal.
Sodium Carbonate, Dry, Na_2CO_3.....	10	...
Gold, as $(NH_4)_2AuCl_6$.....	2	...
Potassium Cyanide, KCN.....	7	...

Cur. den. 0.1: EMF 2.8: Sp. R. 44: Sp. G. 1.0175 (2½°Be.): cur. eff. 99%; deposit per hour 0.00184 mm.; temp. 20°C. Gold anodes one-third the area of the cathode.

8. NICKEL BATH.

	G. per Liter	Ozs. per Gal.
Nickel Ammonium Sulphate $(Ni\ (NH_4)_2(SO_4)_2.6H_2O$.....	75	10

Cur. den. 0.3; EMF 3.5; Sp. R. 24.6; Sp. G. 1.0479 (6½°Be.); cur. eff. 91.5%; deposit per hour 0.0034 mm.

10. NICKEL BATH. For pointed objects and for the direct nickeling of zinc.

	G. per Liter	Ozs. per Gal.
Nickel Sulphate, $NiSO_4.7H_2O$.....	40	5⅓
Sodium Citrate.....	30	4⅔

Cur. den. 0.27; EMF 3.6; Sp. R. 51.7; Sp. G. 1.0394 (5½°Be.); cur. eff. 90%; deposit per hour 0.00301 mm.

11. BLACK NICKEL.

	G. per Liter	Ozs. per Gal.
Nickel Ammonium Sulphate.....	60	8
Ammonium Sulphocyanide, NH_4CNS.....	15	2
Zinc Sulphate, Cryst, $ZnSO_4.7H_2O$.....	7	1

Use nickel anodes 3 to 4 times the area of the cathode. Cur. den. 0.05; EMF 0.5. The deposit takes on any metal which can be nickeled, but is best over white nickel; the full black is obtained only on polished metal. The solution must be kept strictly

neutral by nickel carbonate, as acid makes the deposit gray or streaky and alkali causes brittleness.

15. SILVER BATH. For heavy plating.

	G. per Liter	Ozs. per Gal.
Silver, as Silver Cyanide	25	3⅓
Potassium Cyanide, KCN	27	3½

Cur. den. 0.3; EMF 1.3; Sp. R. 28.8; Sp. G. 1.0338 (4¾° Be.): cur. eff. 99%; deposit per hour 0.0114 mm. Area of anode equal that of cathode.

17. SILVER STRIKING SOLUTION.

	G. per Liter	Ozs. per Gal.
Silver, as Silver Cyanide	4	½
Potassium Cyanide	100	13⅓

19. AMALGAMATING SOLUTION or QUICK DIP.

	G. per Liter	Ozs. per Gal.
Mercuric Oxide, Red	6	...
Potassium Cyanide	100	...

24. ZINC BATH. Pfanhauser.

	G. per Liter	Ozs. per Gal.
Zinc Sulphate, $ZnSO_4.7H_2O$	100	13⅓
Ammonium Chloride, NH_4Cl	25	3⅓
Ammonium Citrate, $(NH_4)_3C_6H_5O_7$	40	5⅓

Cur. den. 0.5-1.0; EMF. 1.1-2.2; Sp. R. 15.9; Sp. G. 1.0781 (10½°); cur. eff. 100%; deposit per hour 0.0173 mm.

26. ZINC BATH.

	G. per Liter	Ozs. per Gal.
Zinc Sulphate, $ZnSO_4.7H_2O$	150	20
Aluminum Sulphate, $Al_2(SO_4)_3.18H_2O$	50	6 1/6
Sulphuric Acid, H_2SO_4	1	⅛

Preparation of the Metal for Plating.

This is a subject for treatment by the practical plater, and only a few remarks will be made on it here. If the plated metal must present a polished surface, as is usually the case, it is desirable to have a smooth surface on which to plate; for a metal deposit instead of filling up scratches and holes magnifies them, by being thinner at the bottom of depressions than on the level surfaces. In nickeling the deposit is much harder than the original metal, and the labor of removing scratches is much greater after plating than before; the increased thickness of the deposit made necessary by the more severe polishing is an added expense when plating is done on a rough or scratched surface.

It should be kept in mind, however, that adhesion of the deposit on a highly polished surface is much less than on a slightly roughened one, and in plating with a metal which has a tendency to peel, like nickel, it may be desirable, after polishing sufficiently to remove scratches, to produce a slight roughness by scouring with a very fine-grained abrasive.

Removal of Grease.

The cake used in polishing consists of an abrasive held together by a mixture of grease and other substances. The polishing therefore leaves the metal covered with a coating of grease that would prevent adhesion of the deposit unless entirely removed. Vegetable and animal fats are converted into soap (are saponified) by the action of a hot solution of lye (potassium hydroxide, KOH, or sodium hydroxide, NaOH); mineral oils, however, are not saponifiable, and hence are not removed by lye. The carbonates of potassium and sodium, K_2CO_3 and Na_2CO_3, are much used in cleaning compounds, but are much less vigorous in their action on fats than the hydroxides. The carbon dioxide of the air gradually converts the hydroxides into carbonates, so that an old lye solution is mainly carbonate.

Sodium carbonate is found on the market in two forms: sal soda, and soda ash. The former is $Na_2CO_3.10H_2O$, the latter is about 97% Na_2CO_3. In purchasing or using sal soda that has not effloresced (turned white by evaporation of some of its water of crystallization) it should be remembered that it contains only 36% of real Na_2CO_3; as water is lost the per cent of Na_2CO_3 rises.

Effect of Heat on Chemical Action.

Heating a solution greatly increases the rate of any chemical action which may be taking place in it. To save time, when dissolving a metal in an acid, heat is applied. The speed with which grease is converted into soap by lye increases with rise of temperature, and for this reason the lye tank should be kept nearly, if not quite, boiling.

The Electric Cleaner.

The use of the electric current as a help in removing grease from metals has now become very general, and is much more rapid than purely chemical action. Electric cleaning consists in using the object from which it is desired to remove the grease as cathode in a hot solution of a sodium or potassium salt. Flow of current causes decomposition of the salt at the electrodes. At the cathode hydrogen is liberated and sodium hydrate, NaOH, is formed, both in strict accordance with Faraday's law. 26.8 ampere hours will liberate what weight of hydrogen, and form how much sodium hydrate? (2½ gallons of hyrdogen.)

The cleaning effect is two-fold: the lye formed saponifies the grease, and the gas liberated in large amount on the surface of the metal **beneath** the grease and other non-conducting matter pushes off such substances from the metal. The vigor of the action depends on the current density (Why?), so that the full pressure of the dynamo should be used (6 volts at least). Steel anodes may be used, or the tank itself may be connected to the positive terminal of the dynamo; in either case it is necessary to use as electrolyte some compound of sodium that will not cause solution of the iron anode; hydroxides and carbonates are satisfactory in this respect, but sulphates, chlorides, and

nitrates should be kept out of the cleaner if iron anodes are used. The use of lye as the electrolyte for electric cleaning has the advantage that its power as a chemical cleaner is added to the effect of the current, though this may be of only theoretical importance.

In addition to its mechanical effect in removing grease, the hydrogen tends to reduce to metal any oxides, sulphides, etc., which constitute tarnish on metals. Electric cleaning makes possible the removal of grease without using corrosive solutions such as lye, and it is even possible to use a cold electrolyte for special objects that would be injured by a hot solution. The action of a cold solution is much slower and less effective than that of a hot solution.

It is customary to use electric cleaning solutions of half the strength employed for chemical cleaning, and a half pound to the gallon of water is generally employed. Since rapidity of cleaning depends on the current density, a solution of low resistivity is desirable, and for the same reason a boiling solution acts far more rapidly than a cold, or even a warm electrolyte.

Reverse Current Cleaning.

It is the practice of some platers in using the electric cleaner to make the object anode instead of cathode. From the electrochemical standpoint this does not seem advisable. At an insoluble anode in such solutions as are used for electric cleaning oxygen is evolved. Since the volume of oxygen is only half that of hydrogen the mechanical effect of the gas will be less, the reducing power of hydrogen is lost, and there is danger that the oxygen evolved in its stead may form a film of oxide on the metal, which would cause poor adhesion of the deposit; also the film of lye produced at the cathode by the current is now where it can do no good in converting the grease into soap.

To offset these disadvantages of "reverse current" in cleaning there does not appear to be even a single advantage in the removal of grease. Although iron is not soluble as anode in most of the solutions used as electric cleaners, brass and copper are corroded, and it is doubtless for this reason that use of the "reverse current" has found favor only in plating stove parts.

If an electric cleaner is not available for experimenting, one can easily be arranged by attaching a wire from the positive cable of the dynamo to an iron kettle containing a boiling solution of 8 oz of soda ash and 2 oz caustic soda per gallon. Attach the article to be cleaned to a wire directly from the negative cable, without a rheostat.

After polishing a sheet of metal, dip it in water and note the way the water runs from the surface. Now immerse in the electric cleaner for five seconds, rinse, and again note the flow of water from it. Repeat until the water flows evenly from the metal without showing any greasy spots. If an ammeter is available, observe the current, and compute the current density.

For comparison immerse a strip of freshly polished metal

in the hot "potash kettle" for the same length of time, and examine similarly.

Deposition By Immersion.

Dip a piece of clean iron or steel in a dilute solution of copper sulphate for a **few seconds**; it will receive a coating of copper. The addition of a little sulphuric acid to the solution improves the deposit.

The action is as follows: Iron has a greater chemical affinity for SO_4 than is possessed by copper; hence some of the iron goes into solution, unites with the SO_4, forming $FeSO_4$, and displaces an equivalent amount of copper from the copper sulphate, $CuSO_4$. (How much iron must dissolve in order to deposit 38.5 of copper?) The action is just like the dissolving of zinc by sulphuric acid, in which case the zinc goes into solution as zinc sulphate by displacing an equivalent amount of hydrogen from the acid, which plates out on the zinc just as the copper does on the iron, but being a gas it does not stay there as copper does.

The equations representing the action in the two cases are:

$$CuSO_4 + Fe = FeSO_4 + Cu$$
$$H_2SO_4 + Zn = ZnSO_4 + H_2$$

When iron dissolves in sulphuric acid the action is even more like the plating of iron with copper by immersion:

$$H_2SO_4 + Fe = FeSO_4 + H_2$$

Since the driving power which causes the copper to plate out is the dissolving of iron by the solution, it is evident that if the iron is once completely covered by copper the plating out of copper must cease; for this reason thick deposits of metal are impossible by this method of "deposition by immersion." It is impossible to get a perfect deposit free from holes by this means, hence deposition by immersion is useless for the protection of iron against rusting by coating with another metal.

Another difficulty in deposition by immersion lies in the fact that the foundation upon which the deposit is made is being dissolved wherever the solution touches it; it is for this reason that solutions for deposition by immersion should be so dilute that attack of the original metal by the solution is slow. The duration of the immersion should be the shortest that will give a good color. Test on the polishing wheel the durability of the best deposit by immersion that you can get.

The amalgamating solution or "quicking solution" used as a preliminary before silvering articles of brass or copper, acts on this principle; mercury is deposited at the expense of dissolving an equivalent amount of metal from the article that is dipped.

The poor adhesion of deposits made by immersion is seen to lie in the dissolving of the underlying metal during deposition. Any coating afterward put upon this poorly adhering deposit cannot stick better than the foundation on which it rests. It is, therefore, necessary for good electro-plating that the metal which is to be plated **shall not receive a deposit by mere immersion** in the plating bath. If the attack of the object by the solution is

very slow, as when copper is placed in a cyanide silver solution, it may still be possible to secure an adherent electro-plate from a solution which gives a deposit by immersion.

A moment's immersion of a metal in a plating solution tells whether or not that metal receives a deposit by immersion from that bath. This may also be predicted from an inspection of tables of potentials of the metals, which will now be discussed.

Potentials of the Metals.

When two electrodes, one of copper and the other of zinc, are immersed in a solution of sulphuric acid or of any sulphate which does not give a deposit on one of the metals by immersion, there is a difference of potential of one volt between the two electrodes, and the combination constitutes a "voltaic cell." Similarly when any two unlike materials, which are conductors of electricity, are immersed in any electrolyte, a difference of potential is produced and the combination may be considered as voltaic cell; in most cases, however, the difference of potential, or E. M. F., is too small to be useful as a source of electric energy.

By using one metal as a standard, the difference of potential between this and all other metals may be measured, and the metals may then be arranged in order of their potentials. Such an arrangement is called an "electrochemical series." The potential of a metal may vary greatly in different solutions; therefore, an electrochemical series measured in one solution may not be correct in another. Potentials also change somewhat with variations in the concentration of the solution.

Potentials of the Metals.

TABLE 5.

(a) Sulphate		(b) NaCl		(c) KCN		(d) KOH	
Mg.	+1.24	Mg.	+1.14	Al.	+1.06	Al.	+1.06
Al.	1.04	Mn.	0.60	Zn.	0.90	Mg.	0.90
Mn.	0.81	Zn.	0.53	Mg.	0.86	Zn.	0.90
Zn.	0.52	Al.	0.30	Cu.	0.81	Sn.	0.63
Cd.	0.16	Pb.	0.04	Mn.	0.65	Mn.	0.42
Fe.	0.09	Fe.	—0.04	Cd.	0.64	Cd.	0.36
Co.	—0.02	Sn.	—0.07	Monel	0.38	Pb.	0.28
Ni.	—0.022	Cr.	—0.17	Ni.	0.36	Fe.	0.27
Sn.	.....	Bi.	—0.24	Au.	0.34	Bi.	0.04
Bb.	.....	Sb.	—0.29	Sn.	0.30	Ni.	—0.06
H.	—0.24	Cu.	—0.31	Nichrome	.30	Cu.	—0.14
Bi.	—0.49	Ni.	—0.37	Ag.	0.28	C.	—0.14
Sb.	.....	Ag.	—0.62	Pb.	0.15	Ag	—0.33
As.	.....	Au.	—0.62	Sb.	0.13	Au.	—0.33
Cu.	—0.51	Pt.	—0.63	Hg.	0.12	Pt.	—0.37
Hg.	—0.98	C.	—0.63	Bi.	—0.08		
Ag.	—0.97			W.	—0.08		
Pt.	.....			Pt.	—0.08		
Au.	.....			Fe.	—0.12		
				C.	—0.36		
				PbO_2	—0.68		

It will be seen from the occurrence of negative values that zero comes in the middle of the scale, as on a thermometer designed for use in the Klondike; the minus sign means values below zero.

In (a) the potential of each metal was measured very carefully by B. Neumann in a normal solution of the sulphate of that particular metal. (A normal solution contains one chemical equivalent of that substance in grams in each liter.) The other columns are from measurements by students in the author's laboratory, in normal solutions of the substance indicated, and are subject to more or less errors.

From a study of this table many things of interest to the plater may be predicted or explained.

What is the voltage of the primary cell formed by putting a strip of copper and another of zinc into dilute sulphuric acid? In (a) the potential of zinc is +.52 and that of copper is —.51, giving a difference of 1.03 volts for the E. M. F. of the cell.

If a voltaic cell be formed by putting any two of these metals into an electrolyte the direction of current through the electrolyte will be from the metal having the higher potential to the other; current comes out of the cell at the more negative electrode.

Each metal precipitates from solutions any metal below it in the series, the rate of action being indicated by the difference of potential between the two metals. This indicates the impossibility of plating zinc or iron with copper from a sulphate or chloride solution, on account of the rapid deposition by immersion due to the large difference of potentials between the metals. In cyanide solution, however, iron is below all the other metals, hence an iron object can be left in a cyanide solution of copper, silver, zinc or gold for any length of time without receiving a deposit by immersion. This makes it possible to plate iron with copper; the cyanide copper solution must be used until the iron has been completely covered with copper, when the object may be transferred to the sulphate bath, and plating continued until a very heavy deposit is obtained.

In an electrolyte containing two or more metals the one that is lower down in the electrochemical series, i. e., the more electronegative, is plated out more readily and in larger proportion; for example, on electrolyzing a solution containing the sulphates of copper and zinc only copper is deposited, so long as any appreciable amount of this remains in the electrolyte.

It would seem that, by using a very high current density, it ought to be possible to deposit copper so rapidly that all of this metal could be removed from the layer of electrolyte in contact with the cathode, when zinc must plate out. Before this condition is reached, however, the current density has become so high that the copper deposit is "burnt" and so, worthless. It is for this reason that the deposition of brass cannot be carried out in chloride, sulphate, nitrate, or acetate solutions, where the difference of potentials between zinc and copper is about one volt.

Inspection of the potentials in cyanide solution shows why this is used as the electrolyte in brass plating; the potentials of copper and zinc are only 0.09 volts apart, and hence it is possible to deposit zinc along with copper from this solution without having to use a current density so high as to produce a burnt deposit. As would be expected from the table, copper deposits in larger proportion than zinc; increasing the amount of either metal in the electrolyte, of course, gives a larger proportion of this metal in the alloy deposited, and so affects the color of the plate.

What would be the effect on the color of the brass deposit of an increase in current density?

How should heating the solution affect the color of the deposit?

The proportions of copper and zinc in the deposit depend on two factors only, the current density, and the amounts of the two metals in the film of electrolyte in actual contact with the cathode. So long as there is enough copper in actual contact with the cathode to carry all the current, only copper will be deposited; to obtain any zinc in the deposit the current density must be raised to such an extent that diffusion, circulation, etc., do not bring copper to the cathode fast enough for this to carry all the current. Whatever increases the rate at which copper is brought to the cathode causes the deposit to contain a larger proportion of this metal, and hence gives a redder brass; increasing the amount of copper in the electrolyte, heating, and stirring have this effect. Raising the current density gives brass of a lighter color, and lowering the current density causes the brass to become more red in tone.

The amount of free cyanide present affects the potentials of zinc and copper, and hence is an important factor in the color of brass deposits.

Whether or not electro-plating with another metal will protect iron from rusting is also indicated by the table of potentials. Electro-plate of the thickness usually used on iron is very thin and contains numerous holes which leave the iron exposed. If the metal which forms the coating is of higher potential than iron, the former will act as anode and the iron will be cathode in the voltaic cell formed whenever the plate is moistened; such a condition protects iron from rusting. If, however, the coating has a lower potential than iron, the iron will be anode, and will corrode very rapidly wherever any of it is exposed. Of all the metals which can be plated out of a solution in water the only ones which are higher in potential than iron are zinc and cadmium; these then are the only metals that can protect iron by galvanic action, and they only should be considered as a protective coating for iron for out of doors use, unless the coating can be made so thick and free from holes or thin spots that there is no danger that the iron will ever become exposed to the air.

(TO BE CONTINUED)

CYANIDE COPPER PLATING.

Discussion brought out by the Educational Committee at the Chicago Branch meeting, March 13, 1920:

Question: What is the best way to do cyanide copper plating? We all have a method, and if you are kind enough to tell us yours, then, after we exchange our ideas, we will have some good information. We will ask of each one, "What, in your opinion, is the best method of cyanide copper plating?"

1. I use about 3 ounces of metal per gallon, and use hypo for a brightener.

2. I most forgot how. I did use about 3 ounces of metal per gallon, and used quite a bit of cyanide, and then run them pretty heavy on wire chairs. I only used hypo for brightener. Some say to use white lead, but I never used it.

3. I had a job of cyanide copper plating. They insisted on copper on the work, and I could not get the thickness in a cyanide solution, so we quit using the cyanide solution.

4. I do a little cyanide copper plating. I usually add a little bisulphate of soda. The solution contains 3 ounces of metal and about 2½ oz. of free cyanide per gallon. I run it cold, and get good results. The work sometimes comes out black; sometimes the solution plates slow; sometimes the anodes turn green. When any of these conditions happen I add cyanide. Once I added too much cyanide and got no plate at all. That is all I can say about it.

5. I do not know anything new. I usually use about 1 ounce of caustic soda, 2 or 3 ounces of cyanide and 3 ounces of metal per gallon, and use it warm, then I add 5 ounces of hypo to every 100 gallons of solution to get a clear color.

6. Instead of using bisulphate of soda to kill the cyanide I add metal and always run it with 2 or 3 ounces of free cyanide to keep the anodes clean. I run my solution warm, 140 to 150 degrees F.

7. My experience has been about the same, but I do not think it is a good plan to have the temperature so high, have it about 90 or 100 deg. F., and it will work pretty fast.

8. It has all been said. When they talk plating solution to me I always want to ask a lot of questions first. I do not believe there is any one method suitable for all purposes. You may have a cold solution in one corner of your factory doing work they want for getting certain efficiency; it may be 25% efficient and entirely satisfactory; perfectly proper for that individual. Another man can use acid copper bath and it does what he wants it to do; it is best for his purpose. Another man may have a hot solution, and he wants to remove grease, and he also wants to throw down into a very small hole; the fellow with a hot copper solution doing satisfactory work, otherwise, probably, cannot thrown into that hole; his process is not good for that particular job. The best way is to get all the details together, sort them out, and find out what you have to do with that copper solution, and make it accordingly.

Question: Talking about hot copper solution, why do they use it hot?

Answer: Because you can use more amperes per square foot of surface in a hot solution than you can in a cold one, consequently you get a faster deposit.

Question: What is the advantage of a hot solution over a cold solution?

Answer: You can plate faster. Your production is greater. You can plate in 5 minutes in a hot solution what it will take probably 30 to 45 minutes to plate in a cold solution. If you had very little floor space and a lot of work, and you were using cyanide copper, instead of putting all the work in a half a dozen tanks that cost $2,000.00 or $3,000.00 to install, you could do the same amount of work in one tank with a hot solution. In 5 minutes you can put on as heavy a plate in a warm solution as you can in 45 minutes in a cold solution. You must have a solution that contains enough metal, enough cyanide, be hot enough, and have enough current to throw that on in a jiffy. Where you can use only 8 amperes to a square foot at most in a cold solution, you can possibly use 60 to 80 amperes in a hot solution, consequently your deposition would be 6 to 8 times faster.

Question: Do you use the same amount of cyanide?

Answer: That is governed by the amount of work you put in the tank and the amperes you use.

Question: Can you do the same work in a hot copper solution that you can in a cold one, and can you do it more economically?

Answer: Yes. I can say this from experience, not only in one case, but probably two dozen. In one place they had 8 eight-foot tanks copper plating on cold rolled steel, and they had something like 70,000 pieces a day to get out, and it was very rarely that they got 9,000 pieces out. They had something like 18 or 20 men in the plating room. They either had to build a larger plating room or get some other method. A larger plating room was out of the question, so a hot copper bath was installed. They installed it in another part of the factory, and, instead of putting in 8 tanks, they put in 2 four-foot steel tanks, and in that put a solution that contained 3 ounces of copper carbonate, 2 ounces caustic soda and 6 ounces of cyanide per gallon. They installed a 2,000-ampere generator, and used 1,000 amperes in each one of those four-foot tanks. They also built hoods over the tanks to take the fumes away; then they made hangers so that 3 of them just filled one of the tanks, and the work was hung on these hangers. In 3 minutes they got sufficient copper on that work to answer their purpose. It took only two men to operate the tanks, one man to load and one man to unload. In those two tanks they did as much work as in the 8 cold tanks. When they put this new plant in they did it with an economy in floor space and in investment. They used just as much cyanide, but they saved a force of 18 men, making a considerable saving all along the line.

WHAT THE BRANCHES ARE DOING

Boston.

President, Andrew Mackie, 831½ East 2nd St., South Boston, Mass.; Secy.-Treas., A. Talamono, 70 Yorktown St., East Somerville, Mass.

Through the untiring efforts of Mr. Frank J. Clark, an associate member of the New York Branch, and Mr. Samuel Herrick, an associate member of the Providence-Attleboro Branch, a sufficient number of electro-platers and chemists, together with some visiting members from the Providence-Attleboro Branch, gathered together in the Adams House in Boston, Mass., for the purpose of organizing a branch of the American Electro-Platers' Society in that city. After an enthusiastic get-together, during which everybody became acquainted, including the Supreme Secretary of the American Electro-Platers' Society, who had journeyed to Boston for the purpose of assisting in the organization of the Branch, Mr. Herrick, as temporary Chairman, called the meeting to order.

Mr. Herrick delivered an address upon the benefits and purposes of the American Electro-Platers' Society, outlining the work that is being done by the different Branches throughout the country, where they meet, and of the assistance that is being given to the American Electro-Platers' Society by the different educational institutions and the U. S. Bureau of Standards.

The Chairman then called upon Mr. John E. Sterling, of the New York Branch, and Supreme Secretary and Treasurer, who spoke of the origin of the Society, the work it has accomplished, and the activities of the various Branches. He dwelt especially on the educational value of membership in the Society.

Mr. Clark was then called upon by the Chairman for a few words, and great interest was shown by all present both in the remarks he made and at the work he had accomplished in endeavoring to organize the Boston Branch of the American Electro-Platers' Society.

The Chairman then called upon Mr. McDonough and Mr. Simpson, members of the Providence-Attleboro Branch, who spoke about what was being accomplished in Providence, and an invitation was extended to all to visit the Providence-Attleboro Branch. This was accepted by most of those present.

The meeting was then thrown open for discussion, but all present were anxious that a Branch be formed and a temporary charter applied for.

The Chairman then called for nominations for temporary President, and Andrew Mackie, of 831½ East 2nd Street, South Boston, was elected President. Mr. Mackie is not only one of Boston's well-known foreman platers, but is also a chemist, and

a well-read man upon the electro-deposition of metals, and it was a pleasure to have him accept the office.

Mr. Talamono, 76 Yorktown Street, Somerville, Mass., a member of the Providence-Attleboro Branch, was elected Secretary-Treasurer. He is so well liked by all members that little has to be said about him.

Mr. Herrick relinquished the chair to the newly elected President, and the following officers were then duly elected:

Vice-President—William French, 90 Roslindale Ave., Roslindale, Mass.

Recording Secretary—Andrew W. Garrett, 37 Dorset St., Dorchester, Mass.

Sergeant-at-Arms—George C. Leach, 185 Campbell Ave., Revere, Mass.

Librarian—H. H. Witcomb, 122 Jason St., Arlington, Mass.

Trustees—Messrs. J. J. Nihan, 38 Howard Ave., Roxbury, Mass.; Louis A. Gale, 47 W. First St., South Boston, Mass.; B. K. Dinjian, 12 State St., Cambridge, Mass.; H. H. Witcomb, 122 Jason St., Arlington, Mass.; R. A. Lafean, 18 Grove St., West Somerville, Mass.

Among the officers of the newly formed Branch are to be one chemist and two electro-chemical engineers, which speaks well for the class of men that got together on this occasion.

Mr. H. H. Witcomb, who has accepted the office of Librarian, is a graduate of the Massachusetts Institute of Technology, will also act as instructor to the Branch.

After the election of officers it was moved and seconded that application be made to the Supreme body for a temporary charter. The same was made out and signed by the ten active and three associate members, and delivered to Mr. John E. Sterling, the Secretary-Treasurer of the American Electro-Platers' Society.

A committee was then appointed to find suitable rooms to hold meetings. The Branch will also endeavor to enlist the aid and co-operation of one of the large educational institutions of the city.

The Branch is also assured of the co-operation of the manufacturers, as many of them have already shown great interest in the Society.

Mr. Herrick had samples of aluminum plated in gold, and a discussion was then taken upon the subject, which was short but very spirited, the President giving the chemical version of the same.

A Boosting Committee was then appointed consisting of all present to obtain as many members as possible, so that the Boston Branch will be able to show a creditable membership roll by the opening of the fall schools.

Although the Boston Branch cannot have a delegate at the Rochester Convention it will have a representative there to boost it along.

The meeting then closed, all present bidding Mr. Sterling farewell, and hoping to see him in Boston again in the near future.

SAMUEL HERRICK.

NOTE—All indications are favorable for a very strong and successful Branch in Boston. Too much credit cannot be given to Messrs. Clark and Herrick for the sincerity of their work in organizing this Branch, which has been crowned with success.

J. E. STERLING, Supreme Secretary.

Pittsburgh.

Meets every first Saturday at 8 p. m. at United States Bureau of Mines Building, Forbes St. Secretary S. E. Hedden, 227 5th St., Aspinwall, Pa.

Meeting of June 5th opened at 8:10 p. m., with President John Corbit in the chair. We had a good attendance, considering the hard rain that lasted all day. We had the pleasure of having Mr. Louis Schulte with us. He happened to be in Pittsburgh, and could not resist the opportunity of coming to the meeting. He told us about meeting with the St. Louis and Chicago branches, and the good work that they are doing.

Two applicants were duly elected to active membership.

After the regular business was taken care of rest of evening was devoted to the coming convention at Rochester, N. Y. By what was said, Pittsburgh Branch will be well represented; one member, who lives in Los Angeles, Cal., is sending a small exhibit, showing the work that is being done out on the Pacific Coast. Owing to our next regular meeting falling on Saturday, July 3rd, meeting date was postponed one week, to Saturday, July 10th, when the report of the delegates will be heard.

Rochester.

Meets on the fourth Fridays. Secretary, Sylvester Gartland, 128 Bryan Street, Rochester, N. Y.

Regular meeting of Rochester Branch was held Saturday evening, May 29th, with President Hesselink presiding.

Two applications for active membership were received.

Constitution amendments were received from the Supreme Secretary. Each member of the Branch present was presented with a copy.

Mr. Joseph Michels plated some check protector parts with Mr. Lovering's magic fluid solution, and exhibited them at the meeting. They were considered good samples of bright nickel.

We are all set for the convention. Committees will be at the trains to greet you and direct you to the hotels. Programs will be mailed to all members of the Supreme Society, also postal cards with a return reply.

Hoping to meet you all in Rochester.

SYLVESTER P. GARTLAND.

Bridgeport.

Meets third Friday of each month in its laboratory, 260 John St., Bridgeport, Conn. Secretary, Louis J. Maraffi, 744 Hancock Ave., Bridgeport, Conn.

Our May 21, 1920, meeting was held in the laboratory, with 16 members present. President J. M. Dunn presiding. A sale of 24 copies of Talks to Platers was reported. Mr. Norman Tice was elected as an associate member.

A rising vote of thanks was given to Mr. Royal Clark for his invaluable work as Secretary-Treasurer of our Branch for the past 3 years. Mr. Clark is moving to New Jersey, but we hope to have him back with our Branch some time in the future.

After the routine of business the election of officers was held, and the following officers were elected for the coming year.

President—J. M. Dunn.

Vice-President—John M. Slattery.

Secretary-Treasurer—Louis J. Maraffi.

Librarian—E. A. Maraffi.

Sergeant-at-Arms—John Rall.

Board of Managers—W. G. Stratton, Wm. Flaherty, Philip Willet.

Laboratory Committee—J. M. Dunn, H. Johnquest, Wm. Thompson, W. G. Stratton, E. A. Maraffi.

Our Seventh Annual Banquet, held May 29, 1920, at the Stratfield, was proclaimed a success by all who were present.

At the afternoon session the illustrated lecture on the "Structure of Metal Deposits," by Dr. Wm. Blum of the U. S. Bureau of Standards, proved very interesting and instructive.

After the lecture the following papers were read and opened for discussion: "Mysteries of the Bight Silver Bath," by A. G. Reeve; "Cleaning and Copper Plating in the Same Solution," by William McKeon; "The Use of Cadmium in the Plating Industry," by H. T. Cain.

After dinner was served, President J. M. Dunn introduced Wm. Flannagan as toastmaster. The next speaker was Dr. Blum, who spoke on some of the work being done by the Bureau of Standards.

Following was Miss Zalia Jenks, who conferred upon us the honor of her presence. Her short talk was on Luigis Calvani and Alexander Volta's discovery and experiments, which led to the construction of what is now known as the voltaic pile.

Mr. Dowling was the last speaker of the evening and his poem on Mr. Plater and Mr. Metal made a hit with all the boys.

A fine musical program was very much enjoyed, and dancing was continued until a late hour.

Newark.

Meets first, third and fifth Fridays of each month, 8 p. m., Foresters' Home, 20 Central Ave., Newark, N. J. Secretary, O. F. Carlson, 225 West Grand St., Rahway, N. J.

Regular meeting of Newark Branch, American Electro-Platers' Society, held on May 7th, President Matts in the chair.

Minutes of previous meeting read and approved.

Several communications were read and acted on.

An application for active membership was received from Mr. De Witt Moore, 55 Chester Ave., Newark, N. J.

The Banquet Committee rendered a final report, which showed that the banquet was a financial as well as social success.

It was voted that the balance in the banquet fund be kept in a separate fund for use at next year's banquet.

Nominations for officers:

For President—H. H. Smith, F. W. Matts, Phil. Sievering. For Vice-President—J. L. Merigold, Theo, Kreuter, J. W. Demars, O. J. Sizelove. For Secretary—O. F. Carlson. For Treasurer—C. A. Stiehle. For Librarian—E. W. T. Faint, C. G. Piske.

It was voted that Mr. Smith be authorized to secure a meeting place at Achtel-Stetters, 842 Broad St.

The subject for the evening, nickel barrel plating, was then taken up and discussed by the members present; the plating of die castings was also discussed.

Regular meeting of Newark Branch, American Electro-Platers' Society held on May 21st, Vice-President Sizelove in the chair.

A communication was received from the Metal Industry stating that on account of the condition of the banquet picture when they received it they were unable to make a cut from it, which was the reason it did not appear in the Metal Industry.

Election of officers—The following officers were elected for the ensuing year:

President—Mr. Phil. Sievering. Vice-President—O. J. Sizelove. Secretary—O. F. Carlson. Treasurer—C. A. Stiehle. Librarian—E. W. T. Faint. Sergeat-at-Arms—J. W. Demars. Trustees—H. H. Smith, F. W. Matts, Henry Bergfels.

The meeting was then taken charge of by Librarian Faint, who, after making a few remarks, introduced Mr. L. M Graham, who was scheduled to deliver an address on the construction and operation of low-voltage generators.

Mr. Graham's lecture was of a very instructing nature, and, by the use of the blackboard, he illustrated the construction of the generator, and all the different phases of the electric current; he also explained and illustrated the three-wire system.

The consensus of opinion among the members and visitors seemed to be that Mr. Graham's lecture was the most instructive talk on electricity that had ever been heard in our meetings, and I am sure nearly all came away knowing more about the electric current than they ever did before.

Philadelphia.

Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary, Philip Uhl, 2432 North 29th St., Philadelphia.

The regular meeting of Philadelphia Branch was held on June 4th, with all the regulars present. Four new members were elected, and two delinquents were suspended. The following newly elected officers were installed by Past President Sam Barr: President, D. A. Metz; Vice-President, P. Gorling; Secretary-Treasurer, Philip Uhl; Librarian, Geo. Gehling; Trustees, E. T. Homan, C. E. Bamberg, C. J. Bayer; Delegate to Rochester Convention, Philip Uhl. After this a lively discussion was started on what action sulphate of magnesium had in a nickel solution, all members present getting into the discussion.

On Saturday June 5th, Philadelphia Branch held its smoker and get-together meeting. After the eats and being entertained by the Jazz Band, Mr. F. S. Bruen of Newark, N. J., gave a very interesting talk on tripoli and polishing compounds. We also had the pleasure of having Supreme Secretary-Treasurer J. E. Sterling with us, and telling us of the new branch started in Boston, and Boston Branch was given a rousing welcome to our society. Prof. Hiram S. Lukens of Penn University was then introduced, and gave a very interesting talk, also showing the simple apparatus he devised in getting the metal content of the different solutions. A rising vote of thanks was tendered to Prof. Lukens for his talk and his efforts in making Philadelphia Branch what it is today. Our newly elected President, D. A. Metz, made a good start with an address of welcome to the visitors present. Too much credit cannot be given to our Chairman, John B. Fay, for his efforts in making this affair a grand success. Next meeting will be held July 16, at Penn University, to hear the reports of the Rochester Convention.

Grand Rapids.

Meets on the second Wednesday of the month at The Morton House. Secretary, J. B. Hawley, 130 Stewart St., Grand Rapids, Mich.

At our regular meeting on June 9th, it was decided to send one member to the Convention each year at the expense of the Branch, and the first member to be so honored is C. S. Walley, a most faithful and unselfish worker. On July 14th every member should attend the "Get-Together Meeting" and get an "earful" of the Convention doings from the delegates, Messrs. Allen, Schultz and Knape. The alternates are Messrs. Walley, Poe and Hawley. Plans for holding a picnic in August will also be discussed on July 14th.

Chas. O. Werft has been appointed to do the "writing up" or be "pres agent" for our Branch. Librarian Walley is ready to announce his 1920-21 program, something real good.

New York.

New York Branch of the American Electro-Platers' Society meets every second and fourth Fridays of each month at the Broadway Central Hotel Parlors, New York, N. Y. Secretary, John Burke, 110 Glen St., Brooklyn, N. Y.

May meetings of New York Branch of the American Electro-Platers' Society were well attended; President Sterling presided. One applicant was elected to active membership. A resolution urging the U. S. and British Governments to adopt the Metric system of weights and measures was submitted by Laboratory Chairman Joseph Haas, Jr., and adopted. A paper was read by Mr. Haas entitled, "Unreliable Criticism of Faraday's Laws." The officers for the ensuing year are: President, J. E. Sterling; Vice-President, F. Haushalter; Secretary-Treasurer, J. Burke; Recording Secretary, S. Schubert; Sergeant-at-Arms, J. A. Stremal; Assistant Sergeant-at-Arms, G. Wilson; Librarian, J. Haas, Jr.; Trustees, F. B. Haddow, W. Fischer, J. Minges, H. C. Flamgan, W. Voss. The following Delegates and Alternates were elected to the 1920 Convention: Delegates—F. B. Haddow, J. E. Sterling, G. Wilson; Alternates—W. Fischer, J. A. Straub, A. Grinham. Mr. Stremal exhibited a wonderful shade of rose-gold upon a lamp stand. The stand was gold-plated and finished with a mixture of Venitian red, chrome orange and yellow. Mr. Voss exhibited an aluminum name plate, etched with ferric chloride and blackened in a solution composed of water 1 liter, ammonium molybdate 20 grams, free ammonium hydroride 25 c. c. steel or carbon anodes and a 3-volt pressure is used. Mr. Voss also states that zinc can be blackened in an ordinary black nickel solution if lead acetate is added to the solution. Mr. Woodmansie, of Detroit Branch, told us of his experiments with Mr. Lovering's magic fluid nickel solution. He stated he made a slight change in the formula, but could not get results claimed. Other subjects under discussion were, steel, nickel steel, silver tin and nickel-cobalt solutions.

Detroit.

Meets first Friday in each month at Cass Technical High School, Platers' Classroom, 2nd Avenue and Beech Street, at 8 p. m. Secretary, E. G. Lovering, 562a Grand River Avenue, Detroit, Mich.

June meeting held at Cass School, President Fritz presiding. Communications read and disposed of. Mr. James McFarland elected as an active member. Installation of the new officers and final instructions to the delegates to convention took up most of the time.

General discussion on satin finish nickel.

Owing to Cass School being closed during July and August Detroit Branch will hold their meetings elsewhere. The Secretary will notify the members.

Cleveland.

The Cleveland Branch meets every second and last Saturday of the month at 1344 *East Prospect St. Secretary B. F. McCormick,* 1941 *West 77th St.*

At our meeting on May 29th, Mr. A. M. Finn, formerly with the Bureau of Standards, was elected to associate membership. Our Laboratory Committee is trying out "Magic Fluid," and we soon hope to know more about it.

On June 26th the editor of the Monthly Review has promised to meet with us, and we trust every member will make an effort to attend the meeting on that evening.

St. Louis.

Meets third Saturday of each month at Barr Branch Library, corner Jefferson and Lafayette. Secretary, H. H. Williams, 4156 *Botanical Ave., St. Louis, Mo.*

Some of us are already on the way toward Rochester; others will soon follow. At present time it is expected that E. W. Heil and wife, of Wichita, Kan.; E. J. Musick and wife; H. H. Williams and wife; Hedley J. Richards, and Chas. McGinley will be there from St. Louis Branch.

APPLICATIONS FOR MEMBERSHIP

Newark

DeWitt Moore (active).....55 Chester Ave., Newark, N. J.

ELECTED TO MEMBERSHIP

Bridegport

Norman Tice (associate)....42 Holmes Ave., Waterbury, Conn.

Rochester

Joseph Ciambone (active)..1810 Walnut St., Niagara Fall, N. Y.
Wm. C. Wolfe.....1130 N. Goodman St., Rochester, N. Y.
Arthur J. Mayer.....7 Reed Park, Rochester, N. Y.

Philadelphia

Fred Verrelle.....2115 E. Sergeant St., Philadelphia, Pa.
G. H. S. Reif.....426 N. 9th St., Philadelphia, Pa.
Geo. R. Brady.....1116 Roberson St., Reading, Pa.
Joseph Meyer.....724 Thorn St., Reading, Pa.
Wm. A. Lambert.....618 Washington Ave., Scranton, Pa.

Detroit

James McFarland.....815 N. Harrison St., Saginaw, Mich.

Pittsburgh

Roy L. Prunkark (active).....
.....1227 Liverpool St., N. S. Pittsburgh, Pa.
Geo. W. Dehn (active).....
.....c/o National Casket Co., N. S. Pittsburgh, Pa.

Newark

John Higgins (associate).....783 Ridge St., Newark, N. J.

Cleveland

A. M. Finn (associate).....1878 E. 59th St., Cleveland, O.